

**CLAIMS**

- 1 1. A method of forming an aluminum-comprising physical vapor deposition  
2 target, comprising:  
3 deforming an aluminum-comprising mass by equal channel angular  
4 extrusion, wherein the mass is at least 99.99% aluminum and further  
5 comprises less than or equal to about 1000 ppm of one or more dopant  
6 materials comprising elements selected from the group consisting of Ac, Ag,  
7 As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf,  
8 Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr,  
9 Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm,  
10 V, W, Y, Yb, Zn and Zr;  
11 after the deforming, shaping the mass into at least a portion of a physical  
12 vapor deposition target.
- 1 2. The method of claim 1 wherein the physical vapor deposition target is a  
2 monolithic target.
- 1 3. The method of claim 1 wherein the one or more dopant materials comprise  
2 materials selected from the group consisting of B, Ba, Be, Ca, Ce, Co, Cr, Dy, Er,  
3 Eu, Gd, Ge, Hf, Ho, La, Ni, Nd, Pd, Pm, Pr, Sb, Sc, Si, Sm, Sr, Tb, Te, Ti, Tm, Y,  
4 Yb and Zr.
- 1 4. The method of claim 1 wherein the one or more dopant materials comprise  
2 materials selected from the group consisting of Si, Sc, Ti and Hf.
- 1 5. The method of claim 1 wherein the mass consists of aluminum and from  
2 about 10 ppm to about 100 ppm of the one or more dopant elements.

1 6. The method of claim 1 wherein the mass consists of Al and from about 10  
2 ppm to about 100 ppm of one or more of Si, Sc, Ti, and Hf.

1 7. The method of claim 1 wherein the mass consists of Al and from about 10  
2 ppm to about 100 ppm of Hf.

1 8. The method of claim 1 wherein the mass consists of Al and from about 10  
2 ppm to about 100 ppm of Ti.

1 9. The method of claim 1 wherein the mass consists of Al and from about 10  
2 ppm to about 100 ppm of Sc.

1 10. The method of claim 1 wherein the mass consists of Al and from about 10  
2 ppm to about 100 ppm of Si.

1 11. A method of forming an aluminum-comprising physical vapor deposition  
2 target, comprising:  
3 deforming an aluminum-comprising mass by equal channel angular  
4 extrusion; and  
5 after the deforming, shaping the mass into at least a portion of a physical  
6 vapor deposition target, the physical vapor deposition target having an  
7 average grain size less than or equal to 45 microns.

1 12. The method of claim 11 wherein the mass is formed into an entirety of the  
2 physical vapor deposition target, and further comprising mounting the mass to a  
3 backing plate.

- 1 13. The method of claim 11 wherein the mass is at least 99.99% aluminum and  
2 consists of Al and less than 100 ppm of one or more of Si, Sc, Ti and Hf.
- 1 14. The method of claim 11 wherein the mass is at least 99.99% aluminum, and  
2 further comprises greater than 0 ppm and less than or equal to about 100 ppm of  
3 one or more dopant materials comprising elements selected from the group  
4 consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe,  
5 Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd,  
6 Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl,  
7 Tm, V, W, Y, Yb, Zn and Zr.
- 1 15. The method of claim 11 wherein the mass consists essentially of aluminum.
- 1 16. The method of claim 11 wherein the mass consists essentially of aluminum,  
2 and less than or equal to about 100 ppm of one or more dopant materials  
3 comprising elements selected from the group consisting of Ac, Ag, As, B, Ba, Be,  
4 Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu,  
5 Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru,  
6 S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.
- 1 17. The method of claim 11 wherein the shaping comprises one or more of  
2 forging and rolling of the aluminum-comprising mass at a temperature of less than  
3 or equal to about 200°C.
- 1 18. The method of claim 11 wherein the deforming comprises at least three  
2 extruding steps, each of the at least three extruding steps comprising passing the  
3 mass through two intersecting passages having approximately equal cross-sections.

1 19. The method of claim 11 wherein the deforming comprises at least four  
2 extruding steps, each of the at least four extruding steps comprising passing the  
3 mass through two intersecting passages having approximately equal cross-sections.

1 20. The method of claim 11 wherein the deforming comprises at least six  
2 extruding steps, each of the at least six extruding steps comprising passing the  
3 mass through two intersecting passages having approximately equal cross-sections.

1 21. A physical vapor deposition target consisting essentially of aluminum and  
2 less than or equal to 1000 ppm of one or more dopant materials comprising  
3 elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,  
4 Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,  
5 Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,  
6 Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr; the physical  
7 vapor deposition target having an average grain size of less than 100 microns.

1 22. The physical vapor deposition target of claim 21 having an average grain size  
2 of less than or equal to 45 microns.

1 23. The physical vapor deposition target of claim 21 consisting of Al and less  
2 than 100 ppm of one or more of Si, Sc, Ti; and Hf.

1 24. The physical vapor deposition target of claim 21 consisting of Al and from  
2 10 ppm to 100 ppm of one or more of Si, Sc, Ti; and Hf.

1 25. The physical vapor deposition target of claim 21 consisting of Al and from  
2 10 ppm to 100 ppm of Sc; the target having an average grain size of less than or  
3 equal to 45 microns.

1 26. The physical vapor deposition target of claim 21 consisting of Al and from  
2 10 ppm to 100 ppm of Si; the target having an average grain size of less than or  
3 equal to 35 microns.

1 27. The physical vapor deposition target of claim 21 consisting of Al and from  
2 10 ppm to 100 ppm of Ti.

1 28. The physical vapor deposition target of claim 21 consisting of Al and from  
2 10 ppm to 100 ppm of Hf.

1 29. A film sputtered from a target, the film consisting essentially of aluminum  
2 and less than or equal to 1000 ppm of one or more dopant materials comprising  
3 elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,  
4 Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,  
5 Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,  
6 Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.

1 30. The film of claim 29 consisting of Al and less than 100 ppm of one or more  
2 of Si, Sc, Ti and Hf.

1 31. The film of claim 29 consisting of Al and from 10 ppm to 100 ppm of one or  
2 more of Si, Sc, Ti and Hf.